

The background of the slide is a photograph of a person in a white space suit walking on a reddish-brown, sandy surface that resembles the planet Mars. The person is wearing a full-body white suit with a clear helmet and is carrying a long, thin black antenna or probe. The terrain is flat and dusty, with some faint tracks or indentations in the sand.

MARS2013

Preparing the Human Presence on Mars

**The PolAres Programme of the Austrian Space Forum
Presentation to the Scientific and Technical Subcommittee of the United Nations Committee
on the Peaceful Uses of Outer Space**

**as part of the Human Space Technology Initiative (HSTI) in the framework of the
UN Programme on Space Applications**

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www.oewf.org



ASF Goals and Objectives

- The Austrian Space Forum (Österreichisches Weltraum Forum, OeWF) is a national network for professionals who work for, or are connected to, aerospace industry, space technology, information technology, natural sciences, or science-related public outreach and education.
- The ASF/OeWF serves as a communication platform between the space sector and the public; it is embedded in a global network of specialists from the space industry, research and politics.
- The ASF/OeWF is directed by a core group of space professionals, supported by volunteers who contribute their expertise on a part-time basis
- The ASF/ OeWF is focussing on space science (at present: human/robotic Mars exploration) and on outreach/education
- We are an independent organisation funded through research projects, sponsors, donations and outreach activities.



Mars Analogue Research- what is it?

- A human landing on Mars is a very complex operation
- The time which a human crew will be able to spend on the surface to conduct the science programme will be extremely constrained
- It is therefore very important to develop the procedures which are required to do science efficiently, correctly and safely well ahead of time and to practice them in an environment which is as Mars-like as possible.
- This is done in an “analogue environment”, i.e. a landscape resembling a Martian landscape, combined with equipment which provides a Mars-like look-and-feel, and operational procedures representative for the activities to be carried out during the science programme on the Martian surface
- In addition to the routine procedures it is necessary to develop procedures for contingency situations: e.g. equipment failure, loss of communication, accidents, sickness.
- Thus the ASF hardware is NOT intended to be used on Mars. It is intended to be used in a Mars-analogue environment to help develop a viable programme for the human/robotic exploration of MARS



PolAres: The ASF Mars Analogue Programme

- PolAres is an interdisciplinary programme of the Austrian Space Forum in cooperation with international partners to develop strategies for human-robotic interaction, in preparation for a future human-robotic Mars surface expedition.
- The strategy which we employ is analogue research, i.e. we are conducting experiments in environments as close as possible to the Martian environment
- Environments tested so far have been: permafrost, arid/desert, underground.
- The cornerstones of PolAres are:
 - The AOUDA Mars analogue space suit
Status: operational testing ongoing
 - The PHILEAS semi-autonomous Mars rover
Status: prototype being developed
 - The PASSEPARTOUT balloon designed for operations in the Martian atmosphere
Status: operational; 10 test launches with different science payloads have been conducted using modified weather balloons

PHILEAS Rover Prototypes



PASSEPARTOUT: Lake Balaton from the edge of space



The AOUDA Analogue Space Suit





AOUDA System Overview

- AOUDA is not a space suit, but an analogue suit: it is to be worn in a Mars analogue environment and provides the wearer with a Mars-like touch and feel
- Mass < 45 kg, Hard-Upper-Torso suit, ambient air ventilation
- Outer hull: Panox/Kevlar tissue with aluminium coating
- Modifiable exoskeleton able to simulate various pressure regimes for all major human joints including fingers
- Biomedical and engineering telemetry through W-LAN (i.e. continuous video & audio, various temperatures, voltages, CO₂, GPS, air pressure, humidity, acceleration, ect.), human waste management.
- On-board computing capability for operations and science data analysis
- Advanced human-machine interface including HUD, speech recognition and accelerometer input devices in the gloves;
- On-board power: various buses, main bus: 12 V, 10 Ah
- Communication: W-LAN band: 5 GHz, Back-up analogue radio for contingency situations
- Two prototypes are being tested: one science/ops, one experimental



AOUDA Performance Envelope

- 4 to 6 hours (incl. donning/doffing) field operations have been conducted
- Temperature limits: between -110° C and $+35^{\circ}$ C (tested)
- >1 km W-LAN range (can be extended with directional W-LAN)
- Operational requirements
 - power supply for telemetry laptops & displays
 - Donning/doffing time: approximately 60 minutes, 2 assistants
 - Total system mass including support infrastructure: approx. 100 kg
- Safety requirements
 - Rescue attach points
 - Emergency power-down
 - Emergency escape
- Operational limitations encountered
 - Temperature buildup
 - Operator fatigue



MARS2013 Mission Rationale and Concept

- Several previous field tests have been conducted with AOUDA:
 - Grossglockner field test 2010: suit validation in a permafrost environment
 - Rio Tinto field test 2011: suit validation in a MARS-analogue environment
 - Dachstein field test 2012: suit validation in a subsurface environment (cave)
- MARS2011/Rio Tinto and Mars2012/Dachstein were precursor missions
 - 12 experiment teams from different institutions came together for a coordinated international campaign
 - These field tests sparked the interest of the world wide Mars-analogue research community
- MARS2013 was organized as a research opportunity for international teams
 - Request for proposal issued Q1 2012
 - Proposal review and experiment selection Q2 2012
 - Notification and coordination Q3 2012
 - Mission integration Q4 2012

MARS2013 Implementation

- Mission duration: the month of February 2013
- Mission location: a Mars-analogue site near Erfoud in NE Morocco, selected on the basis of satellite data and a scouting mission
- Mission Support Center ("Ground Station")
Located in Innsbruck, Austria.
- Communication
Local: WLAN and radio
International: satellite based internet and voice
Emergency: satellite phone and emergency radio
- Mission Fidelity
Degree of fidelity can be adjusted
- Partner in Morocco:





Experiments

Antipodes	Maximum distance R/C test (KiwiSpace Foundation, New Zealand)
AMFS SEG	Part of the MATEP ensemble (Medical University Innsbruck, Austria)
CLIFFBOT	Cliff reconnaissance vehicle (Association Planete Mars, France)
DELTA	Assessing the performance parameters of an astronaut (OeWF, Austria)
Deployable Shelter	Mars emergency shelter (TU Vienna, Austria)
ERAS	Command, control and communication test (Italian Mars Society, Italy)
GEOSCI	Geological sample collection (OeWF/ASF, Austria)
Hunveyor	Remote access robotic lander (Obuda University, Hungary)



Experiments, cont'd

IMAMO Inflatable module for Mars and Moon (Inst. Politecnico di Torino, Italy)

LIFE Search for microorganisms (Inst. of Ecology, U. of Innsbruck, Austria)

MAGMA Pathfinder-class rover system (Polish Mars Society, Poland)

MEDIAN Methane detection with Nano-Landers (University College London, UK)

μ EVA Luminescence detection of viable bacterial spores and terbium microspheres

μ SPHERES (Jet Propulsion Laboratory, NASA, USA)

PULI Mobility tests for the Hungarian GLXP rover (Puli Space Tech, Hungary)

SREC Trafficability with rovers (Association Planete Mars, France)

Science bulletin at: <http://blog.oewf.org/en/2013/02/mars2013-science-bulletin-issue-01-15feb2013/>



Mars2013 status as of 14 Feb

- The MARS2013 expedition was successfully deployed in the Moroccan Sahara on Feb 1. Highlights of the mission include:
- Establishing communication channels between the Sahara `Mars Landing Site' and the Mission Support Center in Innsbruck, Austria (`Ground')
- Conducted 10 analogue surface extravehicular activities with 2 spacesuit simulators, including telescience operations in the fields of astrobiology and geosciences.
- These activities included the successful demonstration of remote biomedical support between the spacesuits and medical teams in the Field Operations Center, and the medical team at the Mission Support Center
- Demonstration of teleoperated rovers and communication tests controlled from Innsbruck/Austria, Budapest/Hungary, Warsaw/Poland and Wellington/New Zealand
- Conducted 17 research experiment sets, including planetary protection studies and instruments relevant to astrobiology, such as laser induced fluorescence for biomarker molecule detections, proof-of-concept for a multi-lander methan-detection network instrument under field conditions. etc)

The Austrian Space Forum with its partners from 23 nations acknowledges the substantial support from industrial partners as well as from the Moroccan government.

Mars2013 Impressions





<http://lightbox.time.com/2012/12/19/time-picks-the-most-surprising-photos-of-2012/#78>

